ML model for optimized interface between dispatch and crushing process

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Structure of the model

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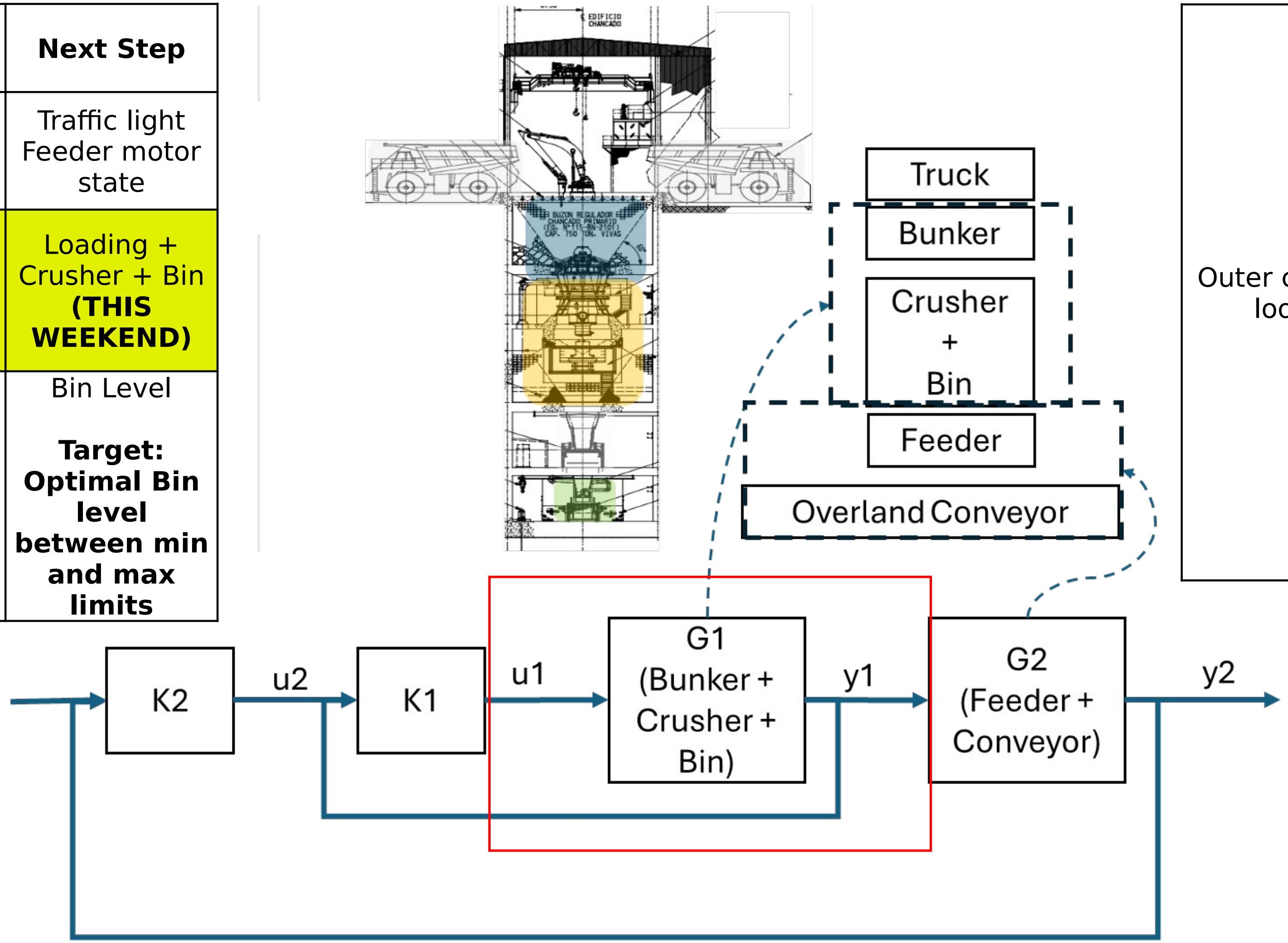
Approach: Identify the dependencies of each component

Inner closed loop	K1 (Controller)	**Next Step**
	u1 (Input)	Traffic light Feeder motor state
	G1 (Model)	Loading + Crusher + Bin **(THIS WEEKEND)**
	y1 (Output)	Bin Level **Target: Optimal Bin level between min and max limits**



Outer closed loop	K2 (Controller)	**Next step**
	u2 (Input)	Traffic light Feeder motor state
	G2 (Model)	Feeder + Conveyor
	y2 (Output)	Output of conveyor **Target: Optimized Flow 10.500 tons/hr**

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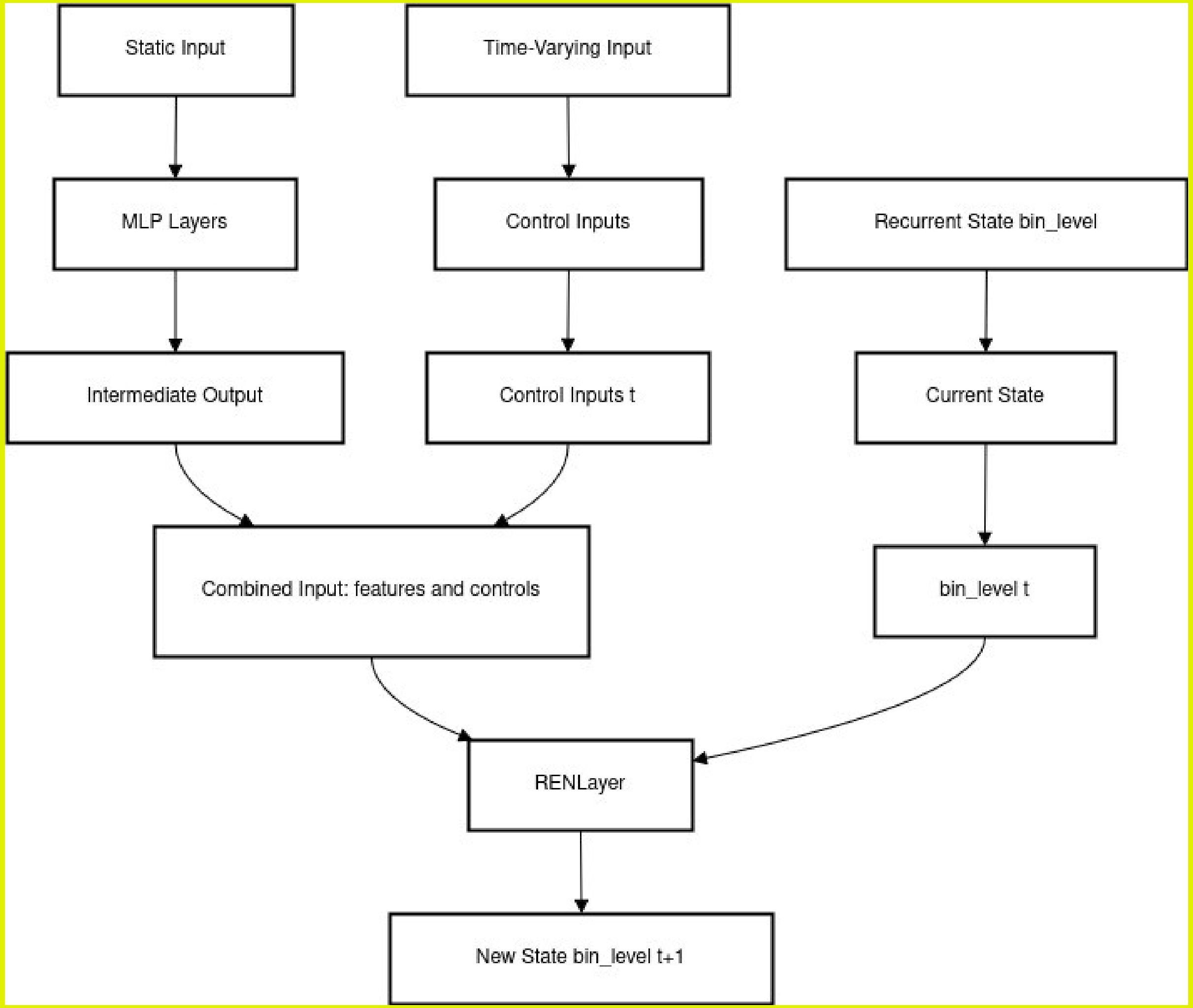
Recurrent Equilibrium Network



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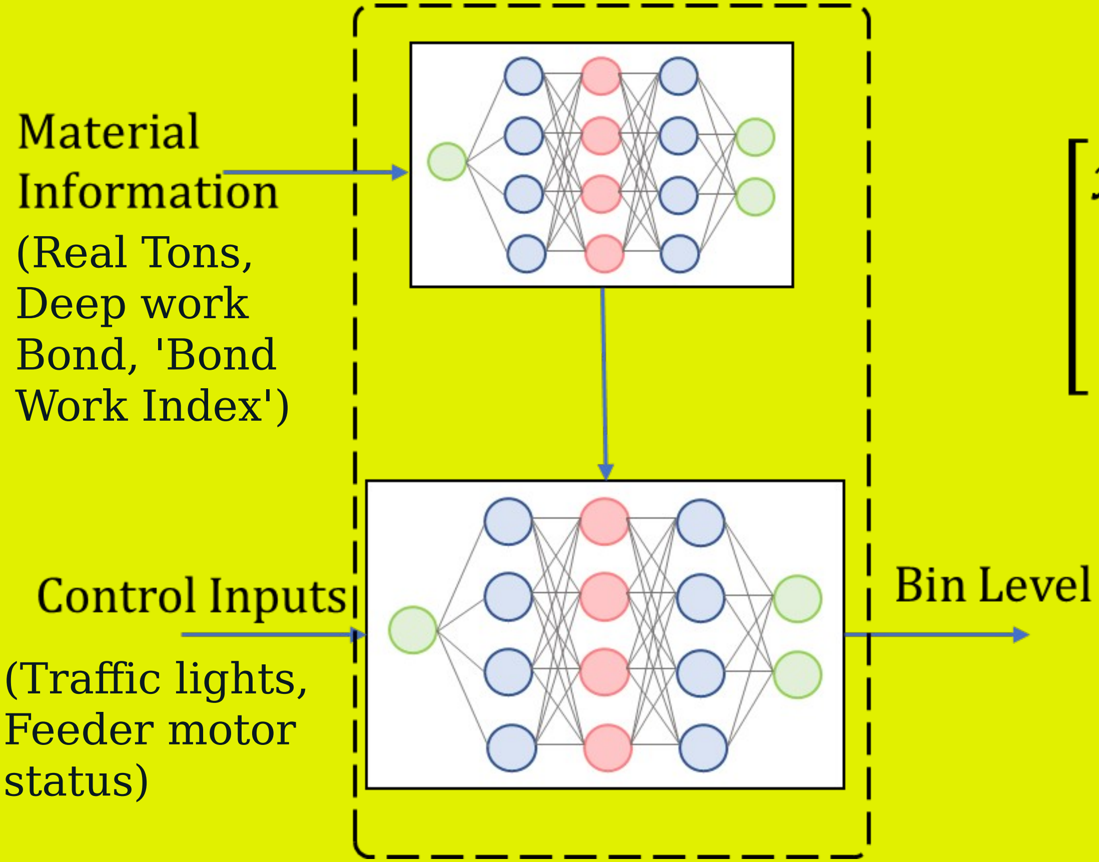
Neural Network to Identify G1


Material Information
(Real Tons, Deep work Bond, 'Bond Work Index')
Control Inputs
(Traffic lights, Feeder motor status)
Bin Level

Mathematical Model of the Network

$$\begin{bmatrix} x_k(k+1) \\ w_k(k) \\ y(k) \end{bmatrix} = \begin{bmatrix} A & B_1 & B_2 \\ C_1 & D_{11} & D_{12} \\ C_2 & D_{21} & D_{22} \end{bmatrix} \begin{bmatrix} x_k(k) \\ w_k(k) \\ u(k) \end{bmatrix}$$

$$w_k(k) = \phi_k(v_k(k))$$

```
class RENLayer(nn.Module):
```

Pre-processing

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Merge of dispatch + data crusher by timestamp

Dumping time for a cycle -> green light

data_preprocessing_REN.py

Variable	CSV Columns	Type	Purpose
first_rows	['Real Tons', 'Bond Work Index', 'Deep Work Index']	Static Inputs	One-time properties (material characteristics).
control_inputs	['traffic_light', 'feeder 1st Motor']	Time-Varying Inputs	Control signals that change over time (operational commands).
Bin_level_input	'Bin Level' (current value)	Recurrent State	Current state of the system (bin fill level).
outputs	'Bin Level' (next value)	Target	The value to predict (next bin level).

Results

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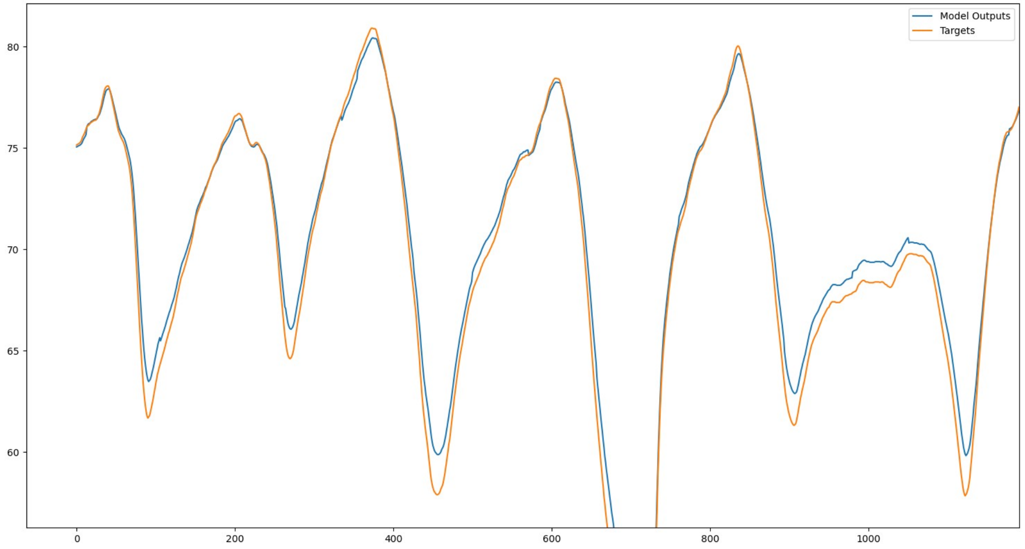
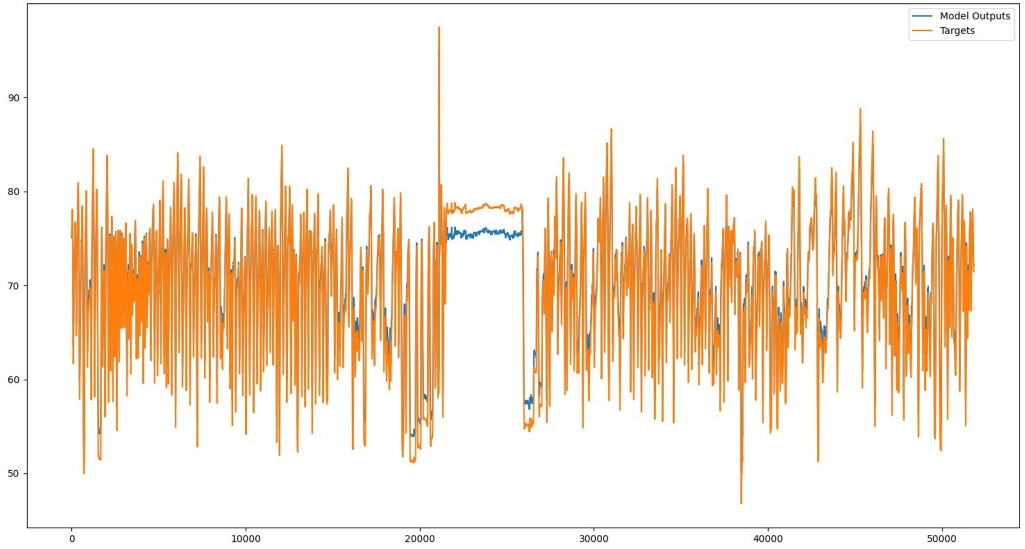
Results: Model able to predict the bin level!





Thank you.

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